Component of Statistics Canada
Catalogue no. 96-325-XIE2007000 Canadian Agriculture at a Glance

Article

The soybean, agriculture's jack-of-all-trades, is gaining ground across Canada

by Erik Dorff, Statistics Canada

October 26, 2007

Statistics Canada Statistique Canada

Canada

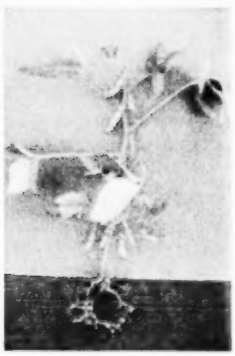
The soybean, agriculture's jack-of-all-trades, is gaining ground across Canada

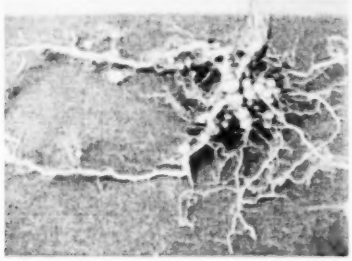
by Erik Dorff, Statistics Canada

When people think of Canadian agriculture, fields of wheat likely come to mind first or maybe tall stalks of corn or grassy slopes of hay. The soybean probably doesn't figure into the picture of Canadian agricultural crops—and with good reason.

Until the mid-1970s, soybeans were restricted by climate primarily to southern Ontario. Intensive breeding programs have since opened up more widespread growing possibilities across Canada for this incredibly versatile crop: The 1.2 million hectares of soybeans reported on the Census of Agriculture in 2006 marked a near eightfold increase in area since 1976, the year the ground-breaking varieties that perform well in Canada's shorter growing season were introduced.

Soybeans have earned their popularity, with the high-protein, high-oil beans finding use as food for human consumption, animal rations and edible oils as well as many industrial products. Moreover, soybeans, like all legumes, are able to "fix" the nitrogen the plants need from the air. This process of nitrogen fixation is a result of a symbiotic interaction between bacteria microbes that colonize the roots of the soy plant and are fed by the plant. In return, the microbes take nitrogen from the air and convert it into a form the plant can use to grow.





This means legumes require little in the way of purchased nitrogen fertilizers produced from expensive natural gas—a valuable property indeed.

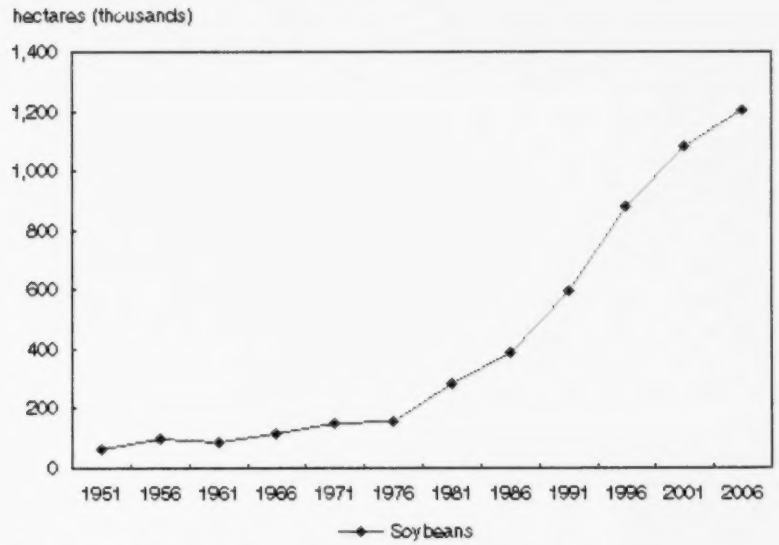
Development of the soybean sector in Canada

While soybeans arrived in Canada in the mid 1800s—with growing trials recorded in 1893 at the Ontario Agricultural College—they didn't become a commercial oilseed crop in Canada until a crushing plant was built in southern Ontario in the 1920s, about the same time that the Department of Agriculture (now Agriculture and Agri-Food Canada) began evaluating soybean varieties suited for the region. For years, soybeans were being grown in Canada but it wasn't until the Second World War that Statistics Canada began to collect data showing the significance of the soybean crop, with 4,400 hectares being reported in 1941. In fact, one year later the area had jumped nearly fourfold, to 17,000 hectares. In 1943 a program aimed at actively breeding soybeans suitable for southern Ontario was initiated.

During the Second World War, North American manufacturers used oil from soybeans not only as a food but also to produce a wide number of industrial products including glycerine for the manufacture of nitroglycerine used for explosives and ammunition.

By 1951, 62,967 hectares had been planted with soybeans (Figure 1), but they were still mostly confined to southern Ontario, the region with the longest and warmest growing season in Canada.

Figure 1 Gains in soybean area reflect crop development efforts



Source: Statistics Canada, Census of Agriculture, 1951 to 2006.

It wasn't until varieties with earlier maturity and improved tolerance of cooler climates were successfully developed—the "Maple" series of soybean cultivars—that significant soybean production was pushed beyond southern Ontario. The 1976 release of the Maple Arrow variety in particular is credited with expanding the range of soybean production into eastern Ontario (Table 1).

Table 1
Census of Agriculture tracks growth in soybean area

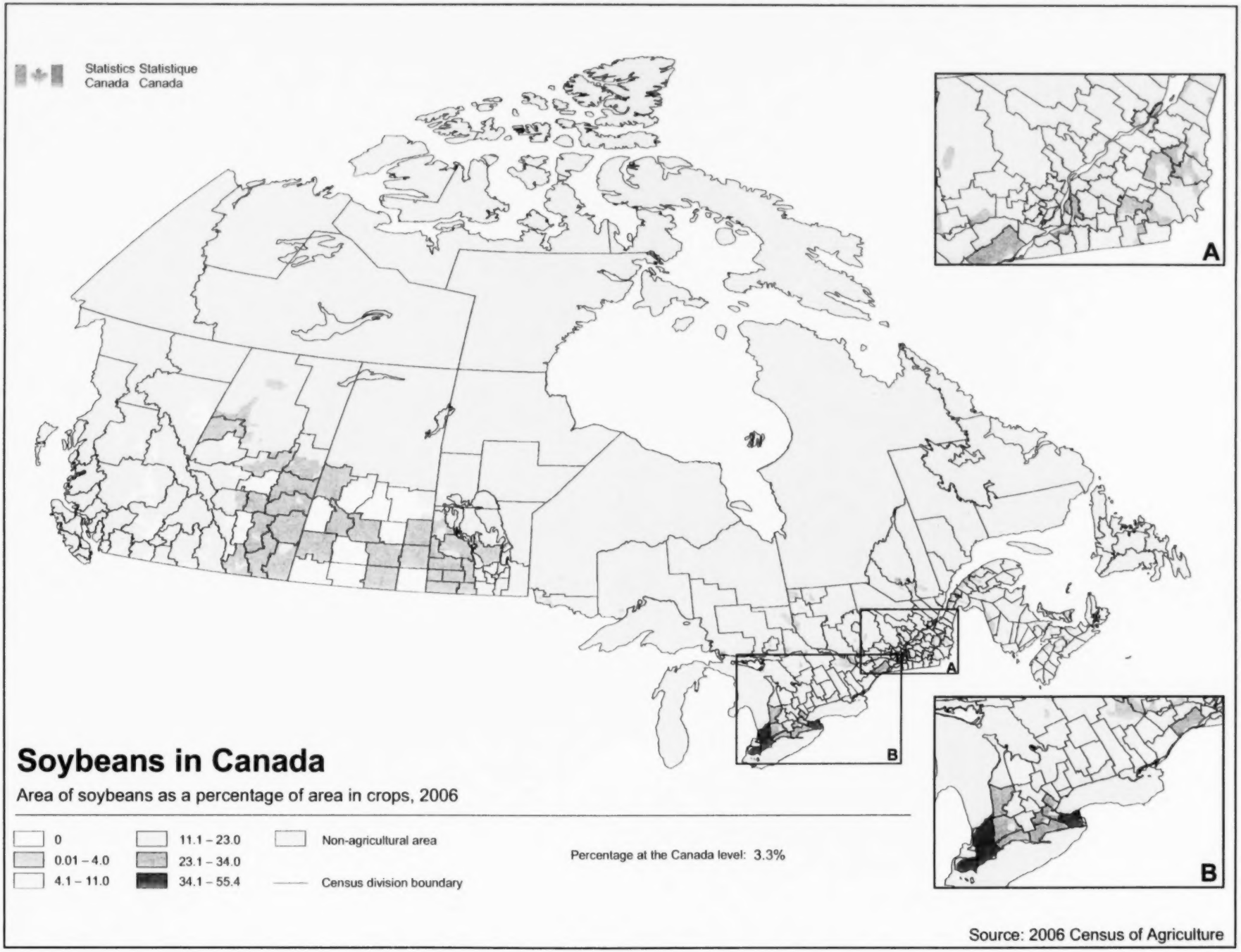
	2006	2001	1996	1991	1986	1981	1976
	hectares						
Canada	1,202,098	1,082,547	876,901	598,454	387,156	282,914	153,793
Newfoundland and Labrador	0	0	0	0	0	0	0
Prince Edward Island	4,580	2,813	2,255	2,378	1,911	42	0
Nova Scotia	958	772	502	185	306	78	17
New Brunswick	762	328	566	18	59	21	4
Quebec	178,161	148,070	96,693	25,271	4,395	1,439	240
Ontario	872,455	909,922	776,209	570,228	380,298	278,853	152,910
Manitoba	141,869	20,249	237	50	139	2,299	309
Saskatchewan	2,229	359	x	0	0	69	183
Alberta	1,083	36	429	323	x	110	127
British Columbia	0	0	x	2	x	2	4

Symbols
x suppressed to meet the confidentiality requirements of the *Statistics Act*
0 true zero or a value rounded to zero
Source: Statistics Canada, Census of Agriculture, 1976 to 2006.

Growth in soybean area across the country

In 1986, 83 farms in Prince Edward Island planted 1,911 hectares of soybeans, joining the 12,122 producers in Ontario and 367 in Quebec who had planted 380,298 and 4,395 hectares of soybeans, respectively, that year.

Map 1: Area of soybeans as a percentage of area in crops, 2006


Statistics Canada
Statistique Canada
A
B
Soybeans in Canada
Area of soybeans as a percentage of area in crops, 2006
0
0.01 – 4.0
4.1 – 11.0
11.1 – 23.0
23.1 – 34.0
34.1 – 55.4
Non-agricultural area
Census division boundary
Percentage at the Canada level: 3.3%
Source: 2006 Census of Agriculture

In 2006 the geographic advance continued as the Census of Agriculture recorded an 11% increase in soybean area from the previous census and a near eightfold increase since 1976. In Ontario, where the crop first gained ground, soybeans occupied the greatest area of any field crop in 2006. However, the growth between 2001 and 2006 was particularly notable in the Prairie provinces, with Manitoba's soybean area increasing sevenfold to over 141,869 hectares and its more western neighbours, Saskatchewan and Alberta, beginning to actively pursue soybean production. These gains in area were the payoff from research aimed at finding and breeding soybean varieties suited to the Prairies as well as from crop promotion and market development.

The soybean—an international super-crop

The soybean's valuable characteristics have propelled it into the agricultural mix in many parts of the world. In 2004, soybeans accounted for approximately 35% of the total harvested area worldwide of annual and perennial oil crops according to the Food and Agriculture Organization of the United Nations (FAO) but only four countries accounted for nearly 90% of the production with Canada in seventh place at 1.3% (Table 2). Soymeal—the solid, high-protein material remaining after the oil has been extracted during crushing—accounts for over 60% of world vegetable and animal meal production, while soybean oil accounts for 20% of global vegetable oil production.

Table 2
Top 10 soybean-producing nations

	Average total production, 2000 to 2005	Global share
	millions of tonnes	percentage
World	225.6	...
1 United States of America	93.1	41.3
2 Brazil	53.4	23.7
3 Argentina	36.4	16.1
4 China	19.4	8.6
5 India	7.0	3.1
6 Paraguay	4.3	1.9
7 Canada	3.0	1.3
8 Bolivia	1.7	0.7
9 Indonesia	0.9	0.4
10 Italy	0.8	0.3

Symbol
... not applicable
Source: United Nations Food and Agriculture Organization, FAOStat, 2000 to 2005.

Canada is a small player in international soybean trade, but an important segment of our domestic soybean production is of specialized high-quality, food-grade beans. Plant breeders have been developing suitable varieties for Canadian farmers in order to capture domestic and foreign—especially Asian—market share for food-grade beans at premium prices.

Soybean dollars make sense for farmers

Breeding advances by scientists made it possible for farmers outside southern Ontario to grow soybeans, but it was the crop's economics that grabbed farmers' interest.

In the 2006 calendar year, farm cash receipts from soybeans amounted to $680 million in Canada, making it the fifth most valuable field crop, trailing canola ($2.5 billion), wheat ($1.8 billion excluding durum), potatoes ($899 million) and corn ($753 million). In Ontario, where it was also the most planted crop, it was the top crop in terms of farm cash receipts, at $547 million, eclipsing the receipts from corn ($449 million) and wheat ($275 million).

International trade contributed to the value of soybean receipts. Preliminary figures place soybean exports at over 40% (1.5 million tonnes) of the soybeans grown in Canada in the 2006 crop year (3.5 million tonnes).

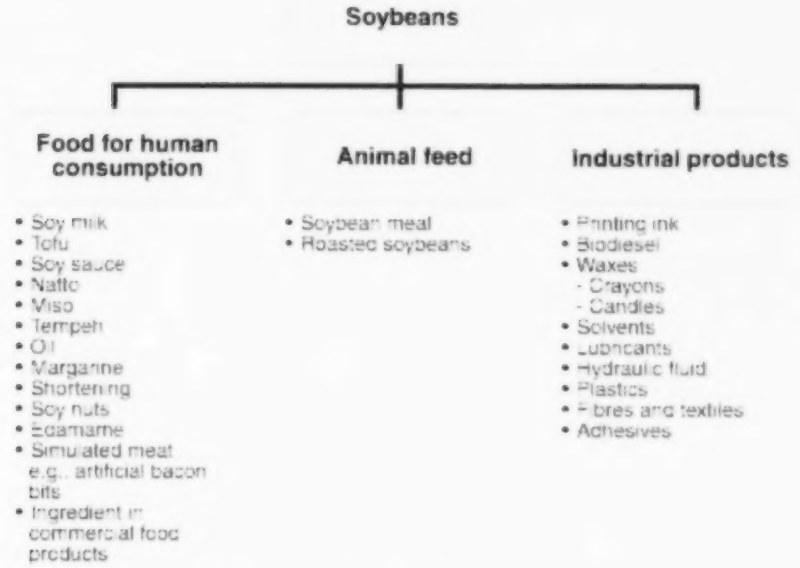
Of the four top buyers in 2006, Japan led the list, importing $138 million in Canadian soybeans, followed by Malaysia ($52 million), the Netherlands ($49 million) and Iran ($43 million). At the same time, Canada imported about 302,000 tonnes of soybeans valued at approximately $81 million, 99% of which came from the United States.

Data on the grade of soybeans exported and imported aren't available. However, Canadian soybean exports averaged $321 per tonne in 2006, while imports averaged $267 per tonne. This discrepancy supports industry claims that Canada's exports focus on premium quality soybeans, whereas lower value beans are imported to supply the domestic crushing and feed sector.

One crop, many uses...

Plant breeders have developed different varieties of soybeans for different uses (Table 3 and Figure 2). For example, soybeans intended for use in soy foods have been selected for their light-coloured seed coat and hilum (the point where the bean attaches to the pod), which gives the final food products a desirable light colour. This characteristic isn't important for soybeans intended for crushing or roasting—where high oil or high protein contents are prime characteristics—so these beans often have a brown hilum and darker seed coat.

Figure 2 One crop many uses

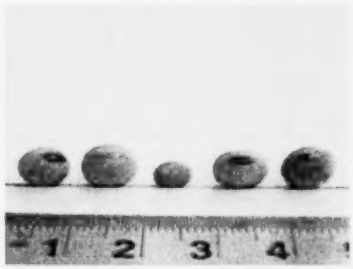


Source: Statistics Canada, Census of Agriculture, 2007

Table 3
Average soybean composition

Characteristic	Oil, feed and meal soybeans	Soy milk/tofu soybeans
Seed size	16 g to 19 g/100 seeds	>20 g/100 seeds
Colour	Beige with dark hilum	Very light with clear hilum
Oil content	18% to 21%	17% to 19%
Protein content	36% to 40%	44% to 47%
Soluble sugar content	10% to 11%	11% to 13%
Insoluble sugar content	21% to 25%	21% to 25%
Minerals	5%	5%
Source: Agriculture and Agri-Food Canada, Cultivating Concepts, 2001.		

Bred in Canada: soybeans of prominence (from left to right)



- **AC Proteus**: Canada's first high-protein soybean—intended for roasting and feeding to livestock.
- **Toki**: A Canadian-developed soybean selected for superior tofu production. Note the light hilum.
- **Nattawa**: Canada's first soybean developed for the natto food market. Note the light hilum and small size.
- **Maple Arrow**: The soybean developed by Agriculture Canada that expanded soybean range out of southern Ontario.
- **Maple Presto**: The jackrabbit of Agriculture Canada soybeans and still the fastest- maturing soybean around.

Food for human consumption

As soybeans moved from their origins in northeastern China into other Asian countries, their high-protein and high-oil nutritional profile made them a staple in many Asian diets.

While important Asian soybean foods included soy milk, miso, tempeh, natto and tofu, it was soy sauce that first drew the attention of the West to the bean. During the 17th century, soy sauce was a popular item in East-West trade. Indeed, it was the prospect of producing soy sauce from the beans that was behind the earliest use in the West.

Soybean oil, extracted from the bean through crushing, is used not only in its original liquid form in cooking and food products but also in solidified form as margarine or shortening.

In addition to traditional soy products, many modern foods employ soymeal as an additive, meat alternative or meat extender. Artificial bacon bits are one example of soy protein being used as a meat alternative, while many processed meat products incorporate soymeal either as a lower-cost alternative to animal products or to achieve desired product characteristics (Table 4).

Table 4
Nutritional comparisons: tofu and soy milk with ground beef and cow's milk

Nutritional content per 100g	Soybean tofu: regular, raw, prepared with calcium sulfate	Ground beef: lean, raw	Soy milk, enriched	2% M.F. fluid cow's milk
Energy (calories)	91.0	234.0	52.0	50.0
Water (g)	79.9	66.5	88.0	89.3
Protein (g)	11.2	19.6	4.5	3.3
Fats (g)	4.5	13.7	1.9	2.0
Carbohydrates (g)	3.7	0	4.9	4.7

Note
M.F. Milk fat.

Source: Health Canada, Canadian Nutrient File, version b, 2007.

Traditional soy foods: a brief guide

- **Edamame**: boiled and salted fresh green soybeans.
- **Miso**: a condiment made from soybeans, a grain, salt and a mould culture. Often used to flavour soups and sauces.
- **Natto**: made from fermented whole cooked soybeans. A source of vitamin B12, often missing in vegetarian diets. Natto is often used as a breakfast food accompanying rice.
- **Soy sauce**: a brown liquid condiment made from fermented soybeans used to flavour rice and other Asian dishes.
- **Soy milk**: a beverage produced from ground soybeans from which the solids have been strained.
- **Tempeh**: whole soybeans, sometimes combined with grain, fermented into a solid cake. A source of vitamin B12, often missing in vegetarian diets. Tempeh is used as a protein source in meals.
- **Tofu**: produced by curdling soy milk, then pressed to remove much of the liquid. Tofu, also know as soybean curd, is used as a protein source in meals.

Animal feed

Since their introduction into North America, soybeans have become a prime source of vegetable protein in animal feeds. In their raw state, however, they contain enzymes (known as tripsin inhibitors) that limit the body's ability to use the bean's protein. Before the beans can be fed to animals, the enzymes need to be destroyed through roasting or processing.

Soybean meal, the solid portion of the soybean remaining after the oil is removed and a product of the soybean-crushing industry, is a very valuable feed component. However, Canada is a large country with relatively little soybean-crushing capacity and, since most of it is in southern Ontario, farmers and feed manufacturers have found other ways to use the soybean in feed.

Many have turned to roasting whole soybeans in order to destroy the enzymes and prepare the beans as animal feed. Since the protein is the more valuable feed component, Agriculture and Agri-Food Canada is focusing on breeding high-protein, low-oil varieties specifically for this type of processing. Efforts are also underway to breed varieties with low or no tripsin inhibitor levels so that soybeans can be used as feed without processing.

Industrial products

While the industrial potential of soybeans has long held appeal (Henry Ford, the founder of the Ford Motor Company, was an early proponent of using soybeans as an industrial source of plastics, fibres and paints), recent concerns over the environmental and security implications of crude oil-derived products has led to a renewed interest in this application.

Printing inks for newspapers are already commonly made from soy oil. Soybean oils are also finding some use as industrial oils and lubricants, as they are especially suited for equipment used in environmentally sensitive areas. Their environmental impact, should the equipment leak, is much less than that of crude oil-based products. One such example is the use of soybean oil-based hydraulic fluids in some logging equipment. Soy oils have also found use in waxes destined for products such as candles and crayons.

It isn't only soybean oil that has attracted industrial attention: Soybean protein has been and continues to be used as a basis for many industrial products. While textiles made from soybean protein have been around for decades, advances in processing have been attracting more attention to these fibres as a component in synthetic fibre blends. Plastics and adhesives for making plywood have also been manufactured from soybeans.

But it is the growing interest in biodiesel, a diesel fuel substitute made from plant or animal oils, that has spurred the greatest interest in this crop from the industrial sector of late. Biodiesel can be made from many oils and fats, both virgin and recycled, and soybeans are only one of many sources—such as canola oil, palm oil and waste fat—

jostling for market share. While some jurisdictions are legislating that diesel fuel have a set proportion of biodiesel for environmental reasons, another solid reason for including it in the diesel fuel sold at the pump is because it substantially reduces engine wear when added to the new low-sulphur diesel fuels.

Soybean not a "has-bean" crop in Canada

Canada's agricultural sector is no stranger to seeing crops wax and wane in popularity only to be replaced by other commodities in farm fields as markets and as farm management methods change. Often the crops that expanded the most are more versatile than others—crops such as canola and soybeans for example. The breeding advances by Canadian plant scientists that have extended the range and tweaked the properties of the versatile soybean have put it in demand from the food, livestock and industrial sectors. Farmers across the country are adding this crop with a bright future to their farm fields. Perhaps the day is not far away when the versatile soybean will join wheat, corn and hay when people think of Canadian agriculture.

The gift of the bean

First domesticated in China, soybeans were adopted as a diet staple through many parts of Asia including Japan, Korea, Indonesia, the Philippines, Vietnam, Thailand, Malaysia, Burma, Nepal and north India between the first and 16th centuries. With about 18% oil and 35% protein, the soybean proved to be a valuable food source.

It appears the soybean first reached North America in 1765 when it was planted in Georgia to produce soy sauce, vermicelli (soybean noodles) and a soy powder. But while soybeans were introduced in North America as early as 1765, it wasn't until after 1850 that they began to really catch on as a crop.

In December of 1850 the sailing ship Auckland left Hong Kong, bound for San Francisco. During the voyage it rescued the crew of a sinking Japanese vessel. When the vessel arrived in the United States, the Japanese were quarantined on the ship. Dr. Benjamin Franklin Edwards of Alton, Illinois was in town and volunteered to perform the medical inspection that declared the Japanese free of contagious disease. In thanks the Japanese gave the doctor a packet of soybean seeds that he carried back to Alton.

A year later, Mr. John Lea, an Alton horticulturalist, planted them in his garden. The following year, seeds from the first crop were grown farther afield by Mr. J. Jackson in Davenport, Iowa and by Mr. A. Ernst in Cincinnati, Ohio. Mr. Ernst distributed the seeds in 1853 to the New York State Agricultural Society, the Massachusetts Horticultural Society, and the Commissioner of Patents. These organizations further disseminated the seed.

By 1855—a mere four years after they were first grown—the seeds had spread from Texas to Canada. The beans, it was suggested to farmers, should be planted in rows 18 to 24 inches apart and cooked prior to being used as hog and chicken feed—uses that continue to characterize the role of the soybean in North American agriculture to this day.

In the years thereafter the soybean's potential for agriculture on this continent was the subject of considerable research and promotion in the United States and the crop's popularity grew significantly both in that country and on this side of the border. Development of a way to produce stable food-quality oils from the soybean and the growth of intensive animal operations have led to the more recent explosion in soybean production.